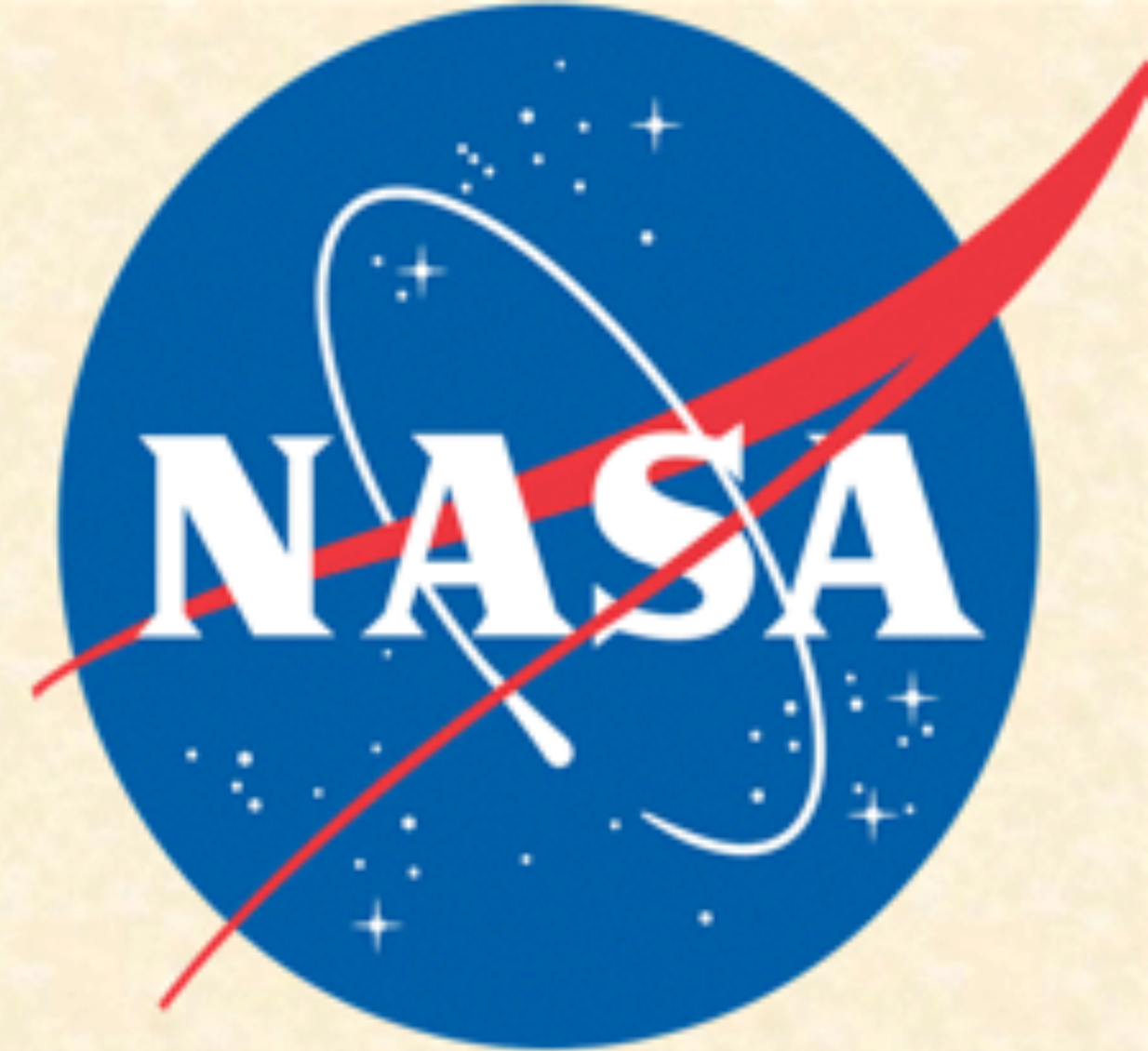




Physical Properties of Meteorite Falls in Relation to Planetary Defense



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Objective:

- Increased awareness of the threat NEA pose to the planet.
- Measurements of the physical properties of meteorite falls are essential in determining how these objects will behave in the atmosphere.
- Will also help determine methods to deflect PHA.
- The Ames Meteorite Characterization Laboratory will measure the physical properties of selected meteorites.

Curation, Sample Preparation, Data Management (1):

- Meteorites cut into 1.5 cm cubes for physical measurements or 5 x 0.5 x 0.25 cm bars for strength measurements.
- All data entered into an on-line database.

Petrographic studies (2):

- Identify unusual features (voids, cracks, shock features, weathering effects) likely to affect the data.

Strength Measurement (7):

- Has direct application to the fragmentation to behavior in atmosphere and deflection.
- Compressive strengths for ordinary chondrites range from 6.3 to 420 Mpa (Svetsov, 1995).
- Compressive, tensile, and deformation strength is measure with Instron 5569 test equipment.

Acoustic Velocity (6):

- Gives insights to the wave propagation through a meteorite and internal structure and porosity.
- Ordinary chondrites longitudinal velocities in the range of 2050 to 4200 m/s (Alexeyeva, 1960).
- Longitudinal and shear wave velocities will be measured using an Olympus 45-MG meter, transducers, electronics and software.

Figure 1 (Right): 3-D mesh of Canyon Diablo. Meteorite type Iron, IAB-MG. Find in 1891 at Meteor Crater, Arizona, United States.

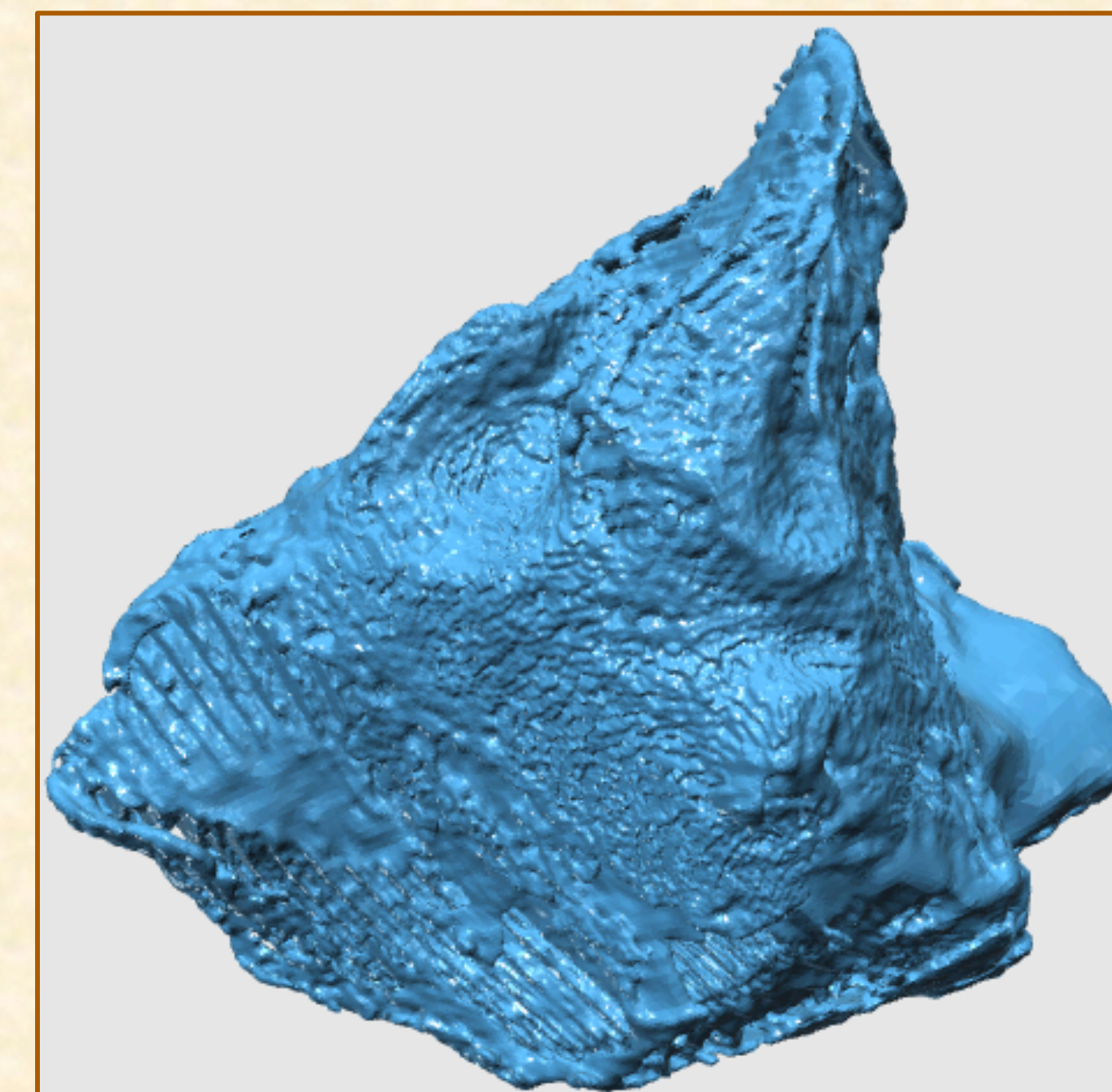
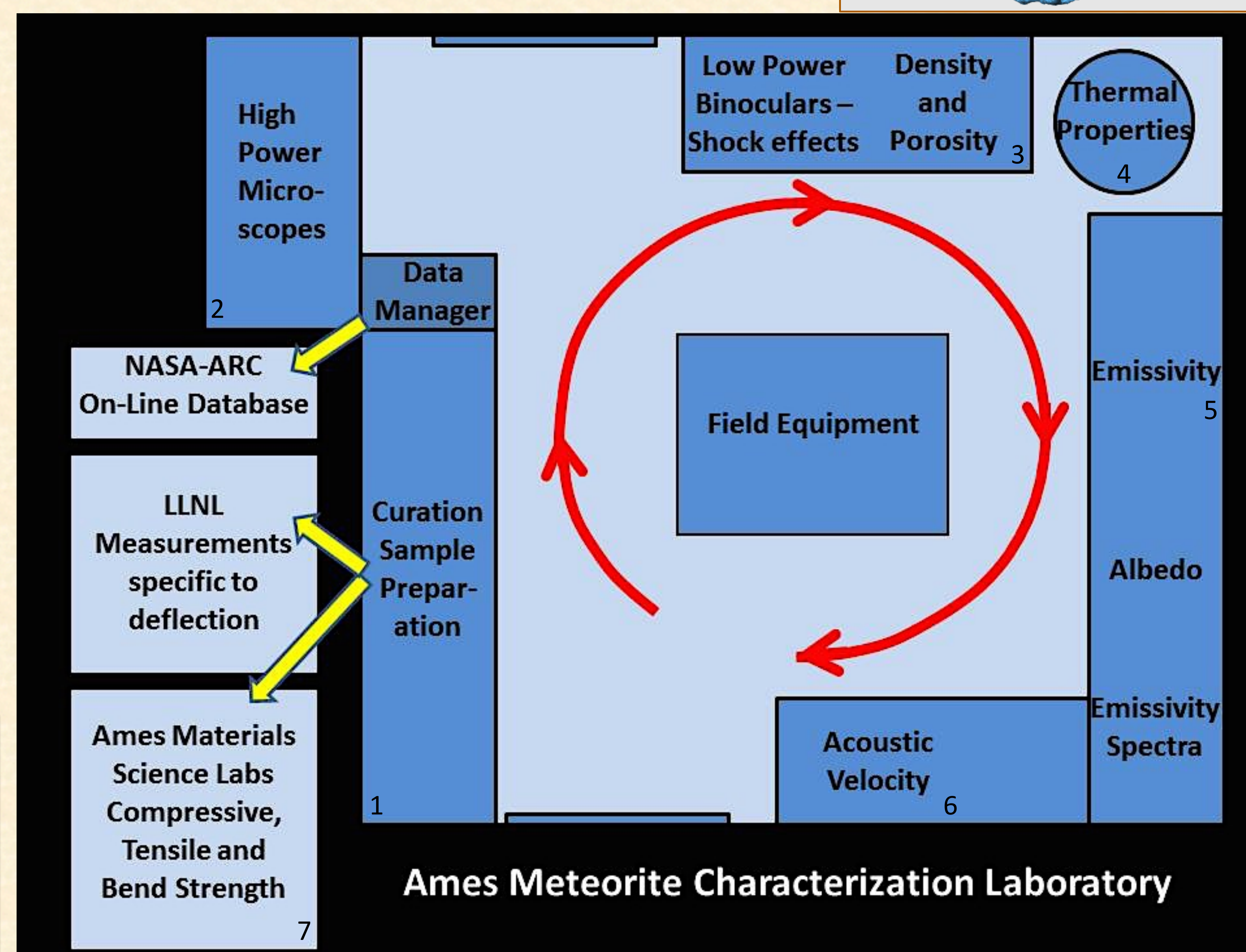


Figure 2 (Below) : Ames Meteorite Characterization Laboratory schematic. The red arrows shows the order of test that each meteorite will under in the laboratory. Sections of each meteorite will be sent to Lawrence Livermore National Labs and Ames Materials Science Labs for other physical properties and deflection test.



Density and Porosity (3):

- Density and porosity are key determinants in meteor behavior in the atmosphere and deflection (McCausland et al. 2011).
- Stony meteorites have densities of 3 to 4 g/cm³, stony-irons are 4 to 6 g/cm³, and irons 7 to 8 g/cm³ (Britt and Consolmagno 2003)
- Volume is determined by a NextEngine 3D laser scanner and density calculated from the weight.
- Porosity is determined using a Quantachrome gas pycnometer.

Thermal Conductivity and Heat Capacity (4):

- Necessary to model the thermal behavior during entry or deflection attempts.
- Thermal Conductivity of meteorites is a factor of 3-10 lower than the pure minerals (Opeil et al. 2012)
- Measurements are made using an Anter Unitherm 2101 Comparative Cut-Bar Thermal Conductivity meter.

Emissivity (5):

- Point measurement over a broad wavelength is needed for atmospheric entry modeling.
- Typical values of emissivity are between 0.9-0.99 for carbonaceous chondrites (Vernazza et al. 2012).
- Measured from room temperature to 1600°C using infrared guns and specially modified ovens/furnaces.

Future Plans:

- Run calibration and method standardization on terrestrial meteorite simulates and Antarctic meteorites
- Obtain ordinary chondrites and other stony meteorites to run the full suite of tests on and generate a thin section of each meteorite



Figure 3: Photograph of the Ames Meteorite Characterization Laboratory.

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